

Paper 1 Multiple Choice

October/November 2021

1 hour

Additional Materials: Multiple Choice Answer Sheet

READ THESE INSTRUCTIONS FIRST

Write in soft pencil.

Do not use staples, paper clips, glue or correction fluid.

Write your name, Centre number and index number on the Answer Sheet in the spaces provided unless this has been done for you.

DO NOT WRITE ON ANY BARCODES.

There are **forty** questions on this paper. Answer **all** questions. For each question there are four possible answers **A, B, C** and **D**.

Choose the **one** you consider correct and record your choice in **soft pencil** on the separate Answer Sheet.

Read the instructions on the Answer Sheet very carefully.

Each correct answer will score one mark. A mark will not be deducted for a wrong answer.

Any rough working should be done in this booklet.

A copy of the Data Sheet is printed on page 19.

A copy of the Periodic Table is printed on page 20.

The use of an approved scientific calculator is expected, where appropriate.

21 Which pieces of apparatus must be used to carry out an experiment to measure the change in temperature when 1 g of magnesium powder is added to excess dilute hydrochloric acid?

- 1 a balance
- 2 a gas syringe
- 3 a stopwatch
- 4 a thermometer

A 1 and 2 B 1 and 4 C 2 and 3 D 3 and 4

22 A colourless solution of P is tested separately with aqueous sodium hydroxide and with aqueous silver nitrate acidified with dilute nitric acid.

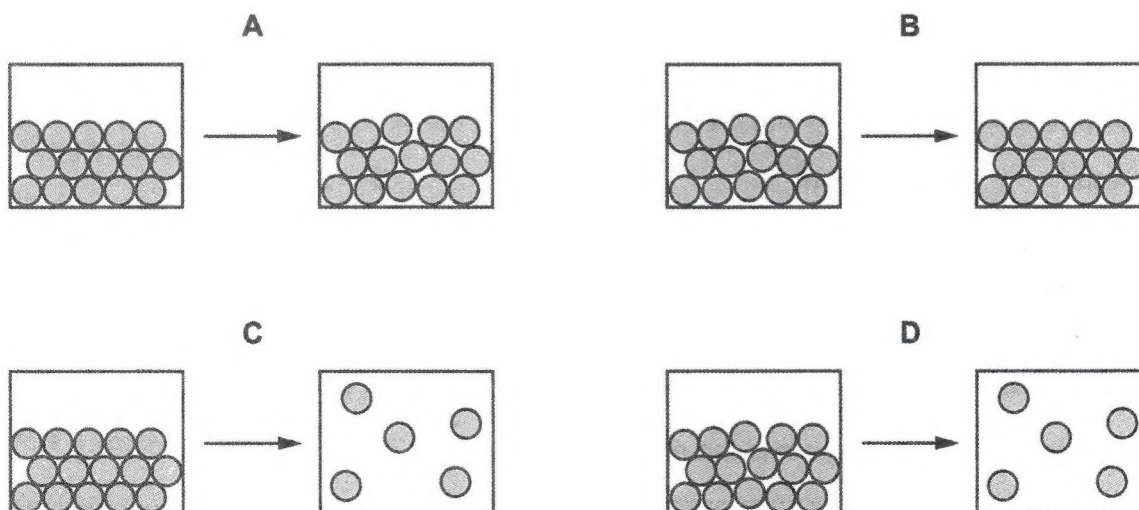
The results are shown.

test	aqueous sodium hydroxide	aqueous silver nitrate acidified with dilute nitric acid
result	white precipitate insoluble in excess	white precipitate

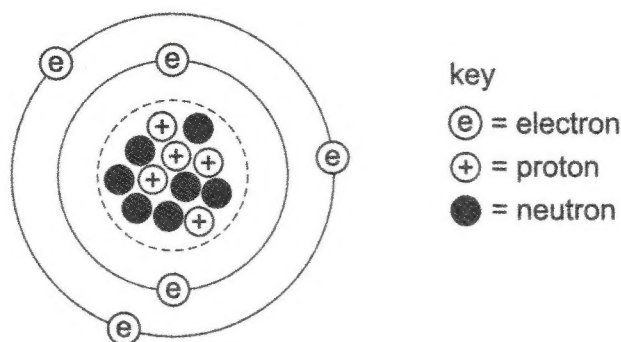
What is P?

- A calcium chloride
- B calcium sulfate
- C zinc chloride
- D zinc sulfate

23 Which diagram represents a change of state in which the energy of the particles is lost?



24 The diagram shows the structure of an atom.



Which atom is represented by the diagram?

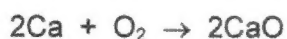
- A $^{11}_5\text{B}$ B $^{12}_5\text{B}$ C $^{12}_5\text{C}$ D $^{12}_6\text{C}$

25 X is a covalently bonded compound made from the elements chlorine and oxygen.

Which 'dot and cross' diagram shows the arrangement of outer shell electrons in a molecule of X?



26 2.0 g of calcium is completely burnt in pure oxygen.



Which volume of oxygen is used in this reaction at room temperature and pressure?

- A 0.025 dm^3 B 0.050 dm^3 C 0.60 dm^3 D 1.2 dm^3

27 The equation for the reaction between dilute sulfuric acid and aqueous sodium hydroxide is shown.



What is the volume of 0.25 mol/dm^3 sulfuric acid that is required to neutralise 20.00 cm^3 of 0.10 mol/dm^3 aqueous sodium hydroxide?

- A 4 cm^3 B 8 cm^3 C 16 cm^3 D 25 cm^3

- 28 The temperatures of dilute hydrochloric acid and aqueous sodium hydroxide are measured separately.

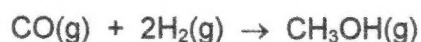
The two solutions are mixed and the temperature of the mixture increases.

Which row describes the type and the energy transfer of the reaction?

	type of reaction	energy transfer
A	endothermic	energy given out to the surroundings
B	endothermic	energy taken in from the surroundings
C	exothermic	energy given out to the surroundings
D	exothermic	energy taken in from the surroundings

- 29 Methanol is manufactured by reacting carbon monoxide with hydrogen in the presence of a catalyst.

The equation for the reaction is shown.



Which changes in pressure and temperature increase the rate of reaction?

	pressure	temperature
A	decrease	decrease
B	decrease	increase
C	increase	decrease
D	increase	increase

- 30 Chemical Z is a powerful reducing agent.

Which statement about Z is correct?

- A Z reacts with aqueous potassium iodide producing a brown solution and gains electrons in the process.
- B Z reacts with aqueous potassium iodide producing a brown solution and loses electrons in the process.
- C Z decolourises acidified potassium manganate(VII) and gains electrons in the process.
- D Z decolourises acidified potassium manganate(VII) and loses electrons in the process.

31 Turmeric is an example of a natural indicator.

It forms a yellow solution in water.

This solution turns red when an alkali or base is added but remains yellow if an acid is added.

Turmeric solution is added to a sample of liquid soap, pH 8, and to vinegar, pH 3.

Which colours are observed?

	liquid soap	vinegar
A	red	red
B	red	yellow
C	yellow	red
D	yellow	yellow

32 The solubility of some salts in water is shown.

soluble	insoluble
barium chloride	barium carbonate
barium nitrate	barium sulfate
sodium chloride	
sodium nitrate	
sodium sulfate	

Which aqueous solutions are mixed to prepare an insoluble salt?

- A** barium carbonate and sodium chloride
- B** barium nitrate and sodium chloride
- C** sodium nitrate and barium chloride
- D** sodium sulfate and barium nitrate

33 Elements X and Y are in the same period of the Periodic Table.

X is a metal and Y is a non-metal.

Which statement is correct?

- A** X has a higher atomic number than Y
- B** X has more electron shells than Y.
- C** Y has a higher atomic number than X.
- D** Y has more electron shells than X.

34 P, Q, R and S are elements.

Some properties of these elements are shown.

element	state at room temperature	product with sodium metal
P	colourless gas	forms Na_2P
Q	pale yellow gas	forms NaQ
R	dark solid	forms NaR
S	colourless gas	no product

Which statement is correct?

- A Q is above R in Group VII of the Periodic Table. P and S are noble gases.
- B Q is above R in Group VII of the Periodic Table. S is a noble gas.
- C Q is below R in Group VII of the Periodic Table. P and S are noble gases.
- D Q is below R in Group VII of the Periodic Table. S is a noble gas.

35 Some properties are listed.

- low melting point
- solid at room temperature
- good conductor of electricity
- good conductor of heat
- forms an acidic oxide

Which of these properties are typical of a non-metallic element?

- A good conductor of electricity and low melting point
- B low melting point and good conductor of heat
- C low melting point and forms an acidic oxide
- D solid at room temperature and forms an acidic oxide

36 W, X, Y and Z are four metals.

W reacts violently with cold water.

X does not react with cold water but reacts with steam.

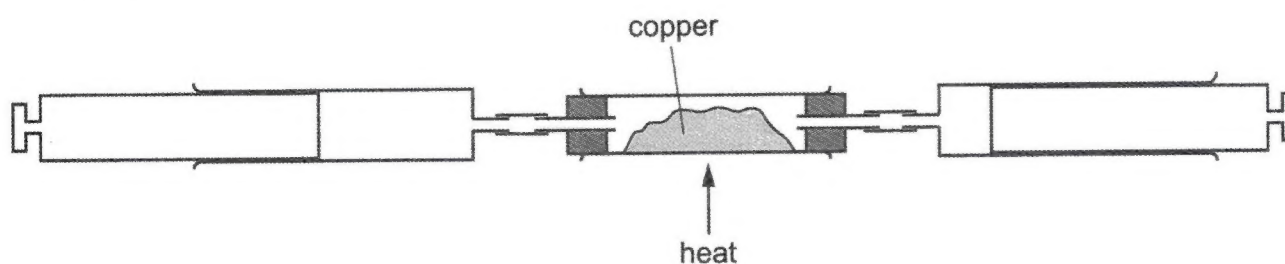
Y reacts slowly with cold water.

Z does not react with hydrochloric acid.

Which row shows the order of reactivity of W, X, Y and Z?

	most reactive → least reactive			
A	W	Y	X	Z
B	W	X	Y	Z
C	Z	X	Y	W
D	Z	Y	X	W

37 80 cm³ of dry air measured at room temperature is passed repeatedly over heated copper using the apparatus shown.



The heated copper reacts with oxygen to form copper(II) oxide.

After the reaction is complete, the air remaining is allowed to cool to room temperature.

What is the volume of air remaining?

- A 1 cm³ B 17 cm³ C 63 cm³ D 79 cm³

38 Petroleum is separated into a number of useful fractions by fractional distillation.

One of the fractions is naphtha.

What is a use of naphtha?

- A feedstock for the chemical industry
B fuel for heating and cooking
C fuel in cars
D making road surfaces

39 Which statements about alkenes are correct?

- 1 They are saturated hydrocarbons.
- 2 They burn in excess air to produce carbon dioxide and water.
- 3 Their general formula is C_nH_{2n+2} .
- 4 They react with hydrogen in the presence of a catalyst.

A 1 and 2 B 1 and 3 C 2 and 4 D 3 and 4

40 The formula of potassium manganate(VII) is $KMnO_4$.

Which statement about potassium manganate(VII) is correct?

- A Ethanoic acid is formed from ethanol in the presence of acidified potassium manganate(VII).
- B Potassium manganate(VII) has a relative formula mass of 126.
- C Potassium manganate(VII) is a reducing agent.
- D Sulfur dioxide turns acidified potassium manganate(VII) from colourless to purple.

Permission to reproduce items where third-party owned material protected by copyright is included has been sought and cleared where possible. Every reasonable effort has been made by the publisher (UCLES) to trace copyright holders, but if any items requiring clearance have unwittingly been included, the publisher will be pleased to make amends at the earliest possible opportunity.

Cambridge Assessment International Education is part of the Cambridge Assessment Group. Cambridge Assessment is the brand name of the University of Cambridge Local Examinations Syndicate (UCLES), which is itself a department of the University of Cambridge.

Multiple Choice Questions

21. (B)

A balance is used to measure the mass of magnesium powder. A thermometer is used to measure the temperature of the mixture.

22. (A)

Calcium ions form a white precipitate with aqueous sodium hydroxide that is insoluble in excess sodium hydroxide.

Chloride ions form white precipitate with aqueous silver nitrate.

EXAM TIP:

Aqueous sodium hydroxide is used to test for cations.
Aqueous silver nitrate is used to test for the presence of chloride ions.

23. (B)

Energy is released when particles change from liquid to solid state.

EXAM TIP:

Solid particles are arranged regularly and close together.
Liquid particles are arranged irregularly and close together.
Gas particles are arranged irregularly and far apart.

24. (B)

The atom has 7 neutrons and 5 protons. Therefore, it has a nucleon or mass number of 12.

Since it has 5 protons, from the Periodic Table, the atom is boron.

EXAM TIP:

Each element is represented by a unique chemical symbol ${}_Z^AX$, where A is the nucleon number, Z is the proton number and X is the chemical symbol of the element.

25. (D)

The oxygen atom has 6 valence electrons, so it will form 2 covalent bonds with 2 chlorine atoms. Each chlorine atom has 7 valence electrons, so it will form 1 covalent bond with the oxygen atom.

EXAM TIP:

Covalent bonds are formed by the sharing of electrons between non-metallic atoms.

26. (C)

$$\begin{aligned}\text{Number of moles of Ca} &= \frac{2.0}{40} \\ &= 0.05 \text{ mol}\end{aligned}$$

$$\begin{aligned}\text{Since 2 moles of Ca react with 1 mole of O}_2, \\ \text{number of moles of O}_2 &= 0.05 \div 2 \\ &= 0.025 \text{ mol}\end{aligned}$$

$$\begin{aligned}\text{Volume of O}_2 \text{ used} &= 0.025 \times 24 \\ &= 0.60 \text{ dm}^3\end{aligned}$$

EXAM TIP:

$$\text{Number of moles of a substance} = \frac{\text{Mass}}{\text{Molar mass}}$$

1 mole of any gas occupies 24 dm³ at r.t.p.

27. (A)

$$\begin{aligned}\text{Number of moles of NaOH} &= 0.10 \times \frac{20.00}{1000} \\ &= 0.002 \text{ mol}\end{aligned}$$

$$\begin{aligned}\text{Since 1 mole of H}_2\text{SO}_4 \text{ reacts with 2 moles of NaOH,} \\ \text{number of moles of H}_2\text{SO}_4 &= 0.002 \div 2 \\ &= 0.001 \text{ mol}\end{aligned}$$

$$\begin{aligned}\text{Volume of H}_2\text{SO}_4 \text{ required} &= 0.001 \div 0.25 \\ &= 0.004 \text{ dm}^3 \\ &= 4 \text{ cm}^3\end{aligned}$$

EXAM TIP:

$$\text{Concentration (mol / dm}^3\text{)} = \frac{\text{Number of moles of solute}}{\text{Volume (dm}^3\text{)}}$$

28. (C)

In an exothermic reaction, energy is given out to the surroundings and results in an increase in the temperature of the mixture.

EXAM TIP:

In an exothermic reaction, energy is given out to the surroundings.

29. (D)

Increasing the pressure of the reactants increases the number of reacting particles at a constant volume, leading to a higher frequency of effective collisions and thus, a faster rate of reaction.

Increasing the temperature increases the kinetic energy of the reacting particles, leading to a higher frequency of effective collisions and thus, a faster rate of reaction.

EXAM TIP:

Increasing the pressure or temperature increases the rate of reaction.

30. (D)

In the presence of reducing agent Z, acidified potassium manganate(VII) turns from purple to colourless when MnO_4^- ions are reduced to Mn^{2+} ions.

Since Z is a reducing agent, it is oxidised and loses electrons in the process.

EXAM TIP:

Acidified potassium manganate(VII) solution is used to test for the presence of reducing agents. In a redox reaction, a reducing agent is oxidised and loses electrons in the process.

31. (B)

Since pH 8 is a slightly alkaline solution, Turmeric solution will turn red in liquid soap. Since pH 3 is an acidic solution, Turmeric solution will turn yellow in vinegar.

EXAM TIP:

A solution with $\text{pH} < 7$ is acidic. A solution with $\text{pH} = 7$ is neutral. A solution with $\text{pH} > 7$ is basic.

32. (D)

To prepare an insoluble salt, mix two aqueous solutions that contain the ions of the salt.

When aqueous solutions of sodium sulfate and barium nitrate salts are mixed, an insoluble salt of barium sulfate will be produced.

EXAM TIP:

Precipitation is suitable for preparing insoluble salts, where two aqueous solutions containing the ions of the salt are mixed.

33. (C)

Across a period, the elements change from metals to non-metals. Thus, Y has a higher atomic number than X. Since X and Y are in the same period, they have the same number of electron shells.

EXAM TIP:

The metallic character of elements decreases across a period. Elements in the same period have the same number of electron shells.

34. (B)

Since the ion of P has a charge of -2 , P is a Group VI element.

Since the ion of Q has a charge of -1 and since Q is a pale yellow gas, Q is a Group VII element (chlorine gas).

Since the ion of R has a charge of -1 and since R is a dark solid, R is a Group VII element below Q.

Since S does not form any product with sodium, S is a noble gas.

EXAM TIP:

In general, Group VI elements form ions with a charge of -2 , Group VII elements form ions with a charge of -1 , and noble gases do not form compounds with other elements. Down Group VII, the colour of the element becomes darker.

35. (C)

In general, a non-metallic element has low melting point, forms an acidic oxide and is a poor conductor of electricity and heat.

A non-metallic element usually exists as a gas or liquid at room temperature due to weak intermolecular forces of attraction.

EXAM TIP:

Non-metals have a simple molecular structure, have low melting points, and are poor conductors of electricity and heat.

36. (A)

W is the most reactive metal as it reacts violently with cold water. Y is less reactive than W as it reacts slowly with cold water. X is less reactive than Y as it does not react with cold water. Z is the least reactive metal as it does not react with hydrochloric acid.

EXAM TIP:

Highly reactive metals can react violently with cold water. Moderately reactive metals can only react with steam or acids. Unreactive metals cannot react with steam or acids.

37. (C)

Dry air consists of approximately 21% oxygen gas. Since only oxygen is used up in the experiment, 63 cm^3 (79% of 80 cm^3) of air remains.

EXAM TIP:

The volume composition of gases present in dry air is approximately 78% nitrogen, 21% oxygen and the remainder (approximately 1%) comprises noble gases (with argon as the main constituent) and carbon dioxide.

38. (A)

Naphtha is used as a feedstock for the chemical industry.

EXAM TIP:

Paraffin (kerosene) is used as a fuel for heating, cooking and for aircraft engines. Diesel is used as a fuel for diesel engine; bitumen is used as a fuel for making road surfaces; petrol is used as a fuel for cars.

39. (C)

Alkenes are unsaturated hydrocarbons with the general formula C_nH_{2n} . They burn in excess air to produce carbon dioxide and water, and react with hydrogen in the presence of nickel catalyst to form alkanes.

EXAM TIP:

Alkenes are unsaturated hydrocarbons with the general formula C_nH_{2n} . Alkenes undergo addition reactions with hydrogen to form alkanes.

40. (A)

Ethanol is oxidised to ethanoic acid in the presence of acidified potassium manganate(VII).

The relative formula mass of KMnO_4 is 158.

Potassium manganate(VII) is a strong oxidising agent. Sulfur dioxide turns acidified manganate(VII) from purple to colourless.

EXAM TIP:

Alcohols are oxidised to carboxylic acids in the presence of acidified potassium manganate(VII).